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The Late Wisconsinan Vertebrate Fauna from Deadman Cave, Southern Arizona

Jim I. Mead
Center for the Study of Early Man, Institute for Quaternary Studies, University of Maine, Orono, Maine 04469

Edward L. Roth
Department of Biology, Howard Payne University, Brownwood, Texas 76801

Thomas R. Van Devender
Arizona-Sonora Desert Museum, Route 9, Box 900, Tucson, Arizona 85743

David W. Steadman
Division of Birds, Smithsonian Institution, Washington, D.C. 20560

Abstract. We report a particularly rich assemblage of fossil vertebrates from a cave in southern Arizona. This fauna provides new data for reconstructing the inadequately known Late Pleistocene-Early Holocene biota of the Sonoran Desert and nearby mountains. The vertebrate fauna of Deadman Cave includes 5 amphibians, 25 reptiles (13 lizards and 12 snakes), 12 birds, and 22 mammals for a total of 64 species. Only one amphibian (*Bufo woodhousei*), three reptiles (*Callisaurus draconoides, Phrynosoma modestum, Gyalopium canum*), and one mammal (*Microtus* species) are locally extirpated, although all still occur in southern Arizona. An unidentified icterine bird may prove to be an extinct species. Extinct mammals include *Euceratherium collinum, Equus* species, and *Nothrotheriops shastensis,* all large herbivores. Other than the extinct animals, the fauna dating of the Late Pleistocene and Early Holocene is little different from that which is available in southern Arizona today. What appears to have changed is the mosaic of the plant and animal community. Distinctly boreal animals are lacking from the fauna. The climate during the time of deposition of the cave sediment appears to have been equable; certain animals now confined to deserts were able to live in more diverse woodland communities.

Introduction

Deadman Cave is a medium-sized, limestone cave at 1400 m (4600 ft) elevation on the northeastern side of the Santa Catalina Mountains, Pima County, Arizona (Fig. 1). The cave is located in the lower portion of the mountain range where various Paleozoic limestone formations are exposed and it appears to be formed in the Mississippian Escabrosa Formation (Wallace 1955).

The present vegetation of this highly dissected area is desert-grassland intermixed with the lower boundary of the oak woodland (*Quercus* species); juniper (*Juniperus erythrocarpa* and *J. deppeana*) is thinly scattered (Whittaker and Niering 1968). Desert-grassland elements such as agave (*Agave parryi*), ocotillo (*Fouqieria splendens*), variable prickly pear (*Opuntia phaeacantha*), and assorted grasses occur on the limestone and conglomerate hillslopes. Tributaries between the hills and the areas of the lower hillslopes are covered with velvet mesquite (*Prosopis velutina*), netleaf hackberry (*Celtis*

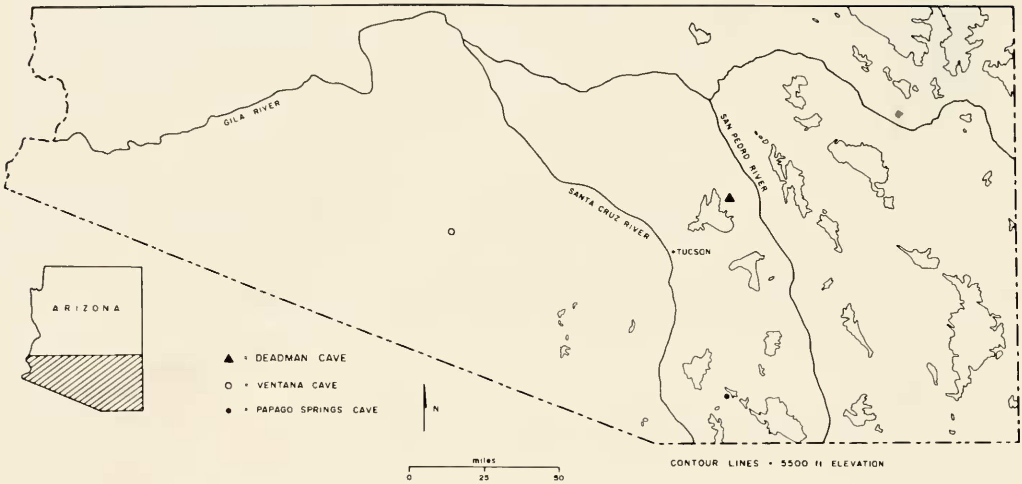

FIGURE 1. Map of southern Arizona with the locations of Deadman, Papago Springs, and Ventana caves. Contour lines (1650 m, 5500 ft) denote the positions of large mountain ranges, illustrating that southeastern Arizona is mountainous with great expanses of woodland and boreal habitats. The southwestern portion of the state contains predominately small desert mountains.

reticulata), and catclaw (*Acacia greggii*). The area around Deadman Cave is presently the ecotone between the creosotebush desertscrub communities of the San Pedro Valley (715 m elevation at the town of Mammoth) and the oak woodland above. Between Deadman Cave and the top of the Santa Catalina Mountains (2790 m elevation) there are Mexican pine-oak woodland, and ponderosa pine and mixed conifer forests.

The approximately three-by-five meter entrance to Deadman Cave is a collapsed cavern ceiling (Fig. 2). The cave once contained an elaborate system of active speleothems. Travertine building is now very rare to absent, possibly because of the development of the present entrance and resultant dessication; rimstone pools rarely contain any water (William Peachey 1980, *personal communication*).

During the late 1800s miners entered the cave to explore the numerous passages. A cabin was constructed across the entrance to the cave. Possibly at the same time, a shaft was begun in a back portion of the cave. This shaft penetrated a travertine surface layer and 2.4 m of cemented rubble containing bones, and provided access to a lower,

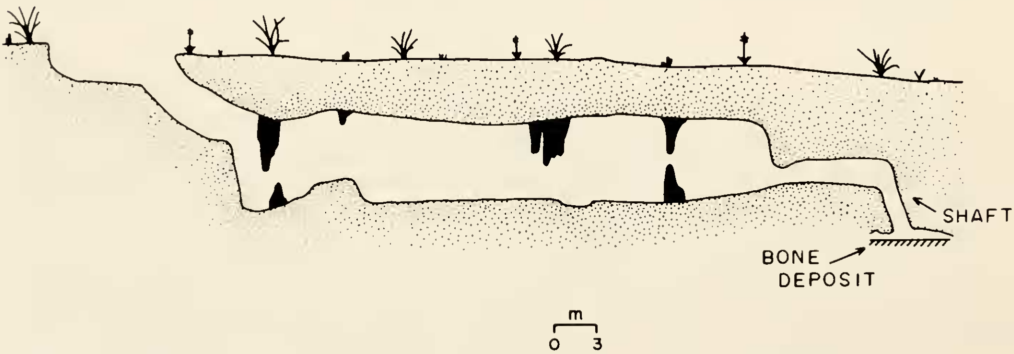

FIGURE 2. Generalized cross section of Deadman Cave, southern Arizona. The present entrance appears to have been the opening during the Late Pleistocene. A shaft built by miners during the 1800s cuts through two travertine layers and provides access to a lower room and the bone deposit, sealed off from the rest of the cave since approximately 8000 B.P.

sealed-off, small room. Here a second travertine layer covered a fine carbonate silt. At this point a trench was excavated horizontally through this loose sedimentary layer and then all mining operations ceased, leaving the exposed shaft and trench walls.

William Peachey informed us of the exposed sediments in Deadman Cave. One of us (ELR) and W. Peachey, entered the cave in 1972 and excavated an approximately 1.0 by 0.5 by 0.5 m layer of loose sediment from below the travertine layer capping the material exposed in the trench wall. All excavated sediments were screened through window mesh (2 mm) sieves. Most of the fossils were identified using the comparative collections at the University of Arizona, Tucson and the Division of Birds, Smithsonian Institution, Washington, D.C.

Chronology

The faunal assemblage contains three extinct species: the Shrub ox (*Euceratherium collinum*), the Shasta ground sloth (*Nothrotheriops shastensis*), and the Horse (*Equus* species). The remainder of the fauna can be found today living in various habitats in southern Arizona. *Euceratherium, Nothrotheriops,* and *Equus* apparently were extinct along with many other large mammals by approximately 11 000 to 10 200 B.P. (years before present; Martin 1967; Mosimann and Martin 1975; Haynes 1968; Meltzer and Mead 1983). The youngest known radiocarbon date on dung of *N. shastensis* is about 10 500 B.P. (Thompson et al. 1980). These dates suggest that at least some of the Deadman Cave faunal assemblage is of Late Wisconsinan age.

A radiocarbon date of 6080 ± 250 B.P. (A-1617) was determined on 14.8 grams of endocarps of *Celtis reticulata* found directly associated with the fauna. Unfortunately there was insufficient CO_2 available for a ^{13}C correction. *Celtis* endocarps are notorious for containing very little carbon and for being easily contaminated by carbonates in percolating water. The sediments had been leached of all organics; some of the bones were encrusted with carbonates. For this reason we believe that the ^{14}C age of 6000 B.P. is probably too young by at least 2000 years. The Deadman Cave faunal assemblage presented here most likely dates between 12 000 and 8000 B.P., grading across the Late Wisconsinan-Early Holocene boundary. Because of the uncertainties of the dating it is not possible to establish unequivocally whether all the reported taxa lived contemporaneously in the local community. The thick travertine cap and the sealing off of the lower room suggests that the deposit has not been contaminated with Middle or Late Holocene bones.

The Fossil Deposit

The fossiliferous layer is a pebbly silt (very pale brown, 7/3 10 YR dry, Munsell color) and shows no physical indication that the sediments were deposited by flowing water. The bones may have accumulated by a number of mechanisms. *Bassariscus astutus* (Ringtail) is a small carnivore that inhabits the cave today; small pockets of bones and seeds are presently developing as the scats of the Ringtail decay. Some of the fossil bone deposit in Deadman Cave may have been developed by the Ringtail as it was 2000 B.P. in Vulture Cave, Grand Canyon, Arizona (Mead and Van Devender 1981). *Spilogale putorius* (Spotted skunk) is the most common carnivore in the fossil deposit and it too may have helped in the accumulation of animal remains.

Owls (*Otus* species—Screech owl; *Micrathene whitneyi*—Elf owl; and *Asio otus*—Long-eared owl) were also recovered from the Deadman Cave deposit. The Long-eared owl is known to prey upon Spotted skunks and is the only owl that inhabits deep recesses in caves, that was recovered from the deposit.

The Ringtail and the Long-eared owl could very well account for the entire fossil deposit except for the larger mammal remains. The cave also may have been a den and a food cache for *Felis concolor* (Mountain lion) or other large carnivores, which could account for the occasional fossil remains of the Mountain lion, Horse, Ground sloth, and Shrub ox.

The area of the bone deposit (Fig. 2) is just beyond view of the light coming in from the present and the presumed Late Wisconsinan-aged cave entrance. From here to the area of the fossil deposit, it is an easy passage for an owl or a mammalian carnivore, across an open, large cavern room. The predators may have had easy access to the lower room where the fossil bone deposit occurs, but the passage has since filled in with travertine, bones, and rock rubble.

Thus, the Deadman Cave fossil deposit is probably time transgressive by possibly a few thousand years, and appears to be an *in situ* deposit from the predator accumulation(s) dating some 8000 to 12 000 years ago.

Results

Fauna

The vertebrate fauna recovered from Deadman Cave (University of Arizona, Laboratory of Paleontology, UALP, locality 78121), is represented by 5 amphibians, 25 reptiles (13 lizards and 12 snakes), 12 birds, and 22 mammals, for a total of 64 species (Table 1).

The following is a systematic account of the fauna. After the skeletal element is the number of specimens, if more than one, and the UALP specimen number. "R" and "L" refer to right and left respectively. A brief discussion of identifying criteria and present-past distributions within the southwestern United States and northern Mexico is included. Our taxonomic sequences, distributional data, and descriptive osteological nomenclature is as follows: amphibians and reptiles—Stebbins (1966); birds—Baumel et al. (1979), Phillips et al. (1964); and mammals—Jones et al. (1982) for extant species and Kurtén and Anderson (1980) for extinct species. Amphibians and reptiles were identified by TRVD and JIM, birds by DWS, and mammals by ELR and JIM.

Class AMPHIBIA—Amphibians
Order ANURA —Toads and frogs
Family Pelobatidae—Spadefoot toads
Scaphiopus species—Spadefoot toad

Material.—Radio-ulna (11411).

Scaphiopus couchi—Couch's spadefoot toad

Material.—Vertebra (11409); R ilium (15312).

Remarks.— Skeletal elements from adult individuals of *Scaphiopus couchi* and *S. hammondi* are distinctive. The shape of the ilium, including the Ala ossa ilei and the Margo dorsalis, identify the fossil specimen as belonging to a spadefoot toad. *Scaphiopus couchi* may be distinguished from *S. hammondi* (Western spadefoot toad) by the following characters: 1) the area from the spina pelvis anterior to the acetabulum is relatively flat on *S. hammondi* but is raised at the acetabulum on *S. couchi*; 2) the articular surface at the acetabulum is curved on *S. hammondi,* but straight on *S. couchi*; and 3) the shape of the Spina pelvis posterior is angular on *S. hammondi,* but curved on *S. couchi. S. couchi* lives in a wide variety of desertscrub, grassland, and subtropical habitats including the Santa Catalina Mountains.

Amphibian subfossil and fossil remains are very inadequately represented in Arizona (Van Devender and Mead 1978, Mead 1981). Besides Deadman Cave, *S. couchi* is known from an Early Holocene age wood rat midden in Arizona (Van Devender and Mead 1978), Late Wisconsinan and Holocene cave deposits in southwestern New Mexico (Van Devender and Worthington 1977, Holman 1970, Brattstrom 1964), and from Rancho la Brisca, Sonora, Mexico (Van Devender et al. in press).

Scaphiopus cf. *S. hammondi*—Western spadefoot toad

Material.—Vertebra (11410).

TABLE 1. Late Pleistocene, Holocene and present fauna from Deadman Cave and other localities in southern Arizona. Sequence and nomenclature is as follows (exceptions—see text): the amphibians and reptiles follow Stebbins (1966), the birds follow Phillips et al. (1964), and the mammals follow Jones et al. (1982) for the extant species and Kurtén and Anderson (1980) for the extinct species. 1 = Van Devender and Mead (1978); Van Devender (1973); Mead et al. (1983). 2 = Haury (1950). 3 = Skinner (1942) and Rea (1980). * = occurs in category. ! = extinct species. S.C.Mt. = Santa Catalina Mountains. ? = Questionable association.

	Present fauna			Wood rat middens[1]		Ventana Cave <10,000 B.P.[2]		Papago Springs Cave[3] Late Pleistocene
	S.C.Mt. or nearby valley	Southern Arizona	Deadman Cave	<10,000 B.P.	>10,000 B.P.	Volcanic unit	Conglomerate	
AMPHIBIANS								
Scaphiopus couchi	*	*	*	*				
S. cf. *S. hammondi*	*	*	*					
Bufo cf. *B. woodhousei*	*	*	*					
B. punctatus	*	*	*		*			
Rana sp.	*	*	*					
REPTILES								
Gopherus agassizi	?	*		*				
Coleonyx variegatus	?	*		*				
Sauromalus obesus		*		*	*			
Holbrookia maculata	*	*	*					
H. texana	*	*	*					
Callisaurus draconoides		*	*					
Crotaphytus collaris	*	*	*	*				
C. wislizeni		*			*			
Sceloporus cf. *S. magister*	*	*	*		*			
S. cf. *S. clarkii*	*	*	*					
S. cf. *S. undulatus*	*	*	*		*			
Uta stansburiana	*	*			*			
Urosaurus cf. *U. graciosus*	* ?	*		*				
U. ornatus	*	*	*					
Phrynosoma douglassi	*	*	*					
P. modestum		*	*					
P. solare	*	*	*					
Cnemidophorus cf. *C. tigris*	*	*		*	*			
Cnemidophorus sp.	*	*	*	*	*			
Heloderma suspectum	*	*	*					
Lichanura trivirgata	?	*			*			
Phyllorhynchus decurtatus	*	*		*	?			
Masticophis sp.	*	*	*	*	*			
Salvadora sp.	*	*	*					
Arizona elegans	*	*	*	*	*			
Pituophis melanoleucus	*	*	*	*	*			
Lampropeltis getulus	*	*	*		*			
L. pyromelana	*	*						
Rhinocheilus lecontei	*	*	*	*	*			
Sonora semianulata	*	*		*	*			
Chionactis occipitalis	*	*		*	*			
Gyalopium canum	*	*	*					
Trimorphodon biscutatus	*	*	*	*	*			
Hysiglena torquata	*	*	*	*	*			
Crotalus atrox	*	*	*		*			
C. cerastes	*	*			*			
C. scutulatus	*	*	*					

Table 1. Continued.

	Present fauna			Wood rat middens[1]		Ventana Cave <10,000 B.P.[2]		Papago Springs Cave[3]
	S.C.Mt. or nearby valley	Southern Arizona	Deadman Cave	<10,000 B.P.	>10,000 B.P.	Volcanic unit	Conglomerate	Late Pleistocene
BIRDS								
Ibis-like								*
Colinus gambelii	*	*	*					
Colinus sp.	*	*	*					
Cyrtonyx montezumae	*	*	*					
Meleagris crassipes								*
Zenaida cf. *Z. macroura*	*	*	*					
Otus sp.	*	*	*					
Micrathene whitneyi	*	*	*					
Asio otus	*	*	*					
Caprimulgidae	*	*	*					
Colaptes auratus	*	*	*					
Turdus cf. *T. migratorius*	*	*	*					
Catharus guttatus	*	*	*					
Icterinae (probably extinct species)			*					
Emberizinae	*	*	*					
MAMMALS								
Notiosorex crawfordi	*	*	*	*	*			
Myotis cf. *M. velifer*	*	*						*
M. cf. *M. evotis*	*	*						*
M. cf. *M. thysanodes*								*
cf. *Myotis*	*	*	*					
Plecotus cf. *P. rafinesquii*	*	*						*
Antrozous pallidus	*	*	*	*				*
Tadarida cf. *T. brasiliensis*	*	*						*
!*Nothrotheriops shastensis*			*			*		
Sylvilagus auduboni	*	*						*
Sylvilagus sp.	*	*	*		*			
L. californicus	*	*				*		*
Lepus sp.	*	*	*	*	*			
Eutamias dorsalis	*	*						*
Eutamias sp.	*	*			*			
Marmota flaviventris								*
cf. *Ammospermophilus*	*	*		*				
Spermophilus variegatus	*	*	*					*
S. tereticaudus	*	*		*				
S. lateralis							*	
Cynomys ludovicianus		?				*		
Thomomys bottae or *umbrinus*	*	*						*
T. cf. *T. bottae*	*	*	*		*			
Perognathus cf. *P. flavescens*								*
P. cf. *P. flavus*	*	*	*					
P. baileyi	*	*		*				
Perognathus sp.	*	*		*	*			
Dipodomys spectabilis	*	*	*					
D. cf. *D. deserti*		*		*				
D. merriami	*	*		*	*			
Reithrodontomys montanus		*	*					

TABLE 1. Continued.

	Present fauna			Wood rat middens[1]		Ventana Cave <10,000 B.P.[2]		Papago Springs Cave[3] Late Pleistocene
	S.C.Mt. or nearby valley	Southern Arizona	Deadman Cave	<10,000 B.P.	>10,000 B.P.	Volcanic unit	Conglomerate	
Reithrodontomys sp.	*	*			*			
Peromyscus maniculatus	*	*						*
P. boylii or *truei*[3]	*/	*/*						*
Peromyscus sp.	*	*	*	*	*			
Onychomys torridus	*	*			*			
O. leucogaster		*						*
Sigmodon cf. *S. arizonae*	*	*	*	*	*			
S. ochrognathus		*			*			
Neotoma albigula	*	*	*		*			
N. lepida		*			*			
N. mexicana or *albigula*[3]	*/*	*/*						*
Microtus sp.		*	*					
M. cf. *M. mexicana*		*						*
Erethizon dorsatum	*	*			*			
Canis latrans	*	*					*	*
C. lupus		?						*
!*C. dirus*							*	
Vulpes macrotis	*	*					*	
Urocyon cinereoargenteus	*	*						*
Ursus americanus	*	*						*
Bassariscus astutus	*	*	*	*				
!*B. sonoitensis*								*
Taxidea taxus	*	*				*		*
Spilogale putorius	*	*	*					*
Mephitis mephitis	*	*						*
M. macroura	*	*	*					
Felis concolor	*	*	*					
!*Panthera leo atrox*						*		
!*Equus tau*								*
!*E. occidentalis*						*	*	
!*E. conversidens*								*
!*Equus* sp.			*					
!*Tapirus* sp.						*	*	
!*Platygonus compressus*								*
Dicotyles (=*Tayassu*) sp.	*	*				*		
!*Camelops* sp.								*
Odocoileus sp.	*	*	*			?		
Cervus sp.								*
!*Stockoceros* cf. *S. conklingi*						*	*	
!*S. onusrosagris*								*
!*Euceratherium collinum*			*					
Bison bison								*
Bison sp.							*	

Remarks.—The shape of centrum and the size of the fossil vertebra was indistinguishable with that of the Western spadefoot toad. *S. hammondi* is widely distributed in southeastern Arizona where it lives in desert, grassland, chaparral, woodland, and pine forest habitats (Lowe 1964). The fossil referred to as cf. *S. hammondi* represents the first fossil occurrence for the species in Arizona. Late Pleistocene and/or Early Holocene age occurrences outside Arizona for this species are known from Nevada (Brattstrom 1976) and New Mexico (Holman 1970).

Family Bufonidae—Toads
Bufo cf. *B. woodhousei*—Woodhouse's toad

Material.—Vertebra (11408).

Remarks.—*Bufo woodehousei* is a large toad in relation to the other species found today in Arizona, although distinctly smaller than *B. alvarius* (Colorado River toad). *Bufo woodhousei* can be identified by: 1) the size is relatively larger at all stages of growth than most other *Bufo,* 2) the neural arch is higher making the centrum more pronounced, and 3) the articular facets are larger. Woodhouse's toad occurs in eastern and central Arizona and in isolated populations in the Yuma area of southwestern Arizona. In southern Arizona *B. w. australis* is primarily a riparian species restricted to permanent or semi-permanent streams. Late Pleistocene or Early Holocene age remains of *Bufo woodhousei* have not been previously reported from Arizona. Outside Arizona, fossil remains of this toad are known from Nevada (Mead et al. 1982) and New Mexico (Holman 1970).

Bufo punctatus—Red-spotted toad

Material.—Urostyle (15002).

Remarks.—*Bufo punctatus* is a small toad with many easily identifiable skeletal elements. The paired anterior condyles of the urostyle are relatively broad, flat ovals as in *B. punctatus.* Juveniles of the larger species of *Bufo,* do not have as flattened an anterior end to the urostyle. This xeric-adapted toad occurs throughout most of the Southwest, living in habitats ranging from desertscrub to Mexican pine-oak woodland. Late Pleistocene remains of *B. punctatus* occur in three Arizona localities (Van Devender and Mead 1978), New Mexico (Holman 1970, Van Devender and Worthington 1977), and Rancho la Brisca, Sonora, Mexico (Van Devender et al. in press).

Family Ranidae—Frogs
Rana species—Frog

Material.—Humerus (11412).

Remarks.—The long, slender humerus is identifiable to *Rana,* but we were only able to identify the fossil to a small species. *Rana pipiens* (Leopard frog) and *R. tarahumarae* (Tarahumara frog) along with the introduced *R. catesbeiana* (Bull frog) occur in southern Arizona today. Only *R. pipiens* and the introduced species occur near Deadman Cave where they are restricted to permanent water habitats along streams. *Rana* species have been recovered as Quaternary fossils in California (Brattstrom 1953*a, b*, Hudson and Brattstrom 1977), Nevada (Brattstrom 1954), New Mexico (Holman 1970, Van Devender and Worthington 1977), and Rancho la Brisca, Sonora, Mexico (Van Devender et al. in press).

Class REPTILIA—Reptiles
Order SQUAMATA—Lizards and Snakes
Suborder Sauria—Lizards
Family Iguanidae—Iguanid lizards
Holbrookia maculata—Lesser earless lizard

Material.—Dentary (11394).

Remarks.—The Lesser earless lizard is a small ground-dwelling lizard common in open habitats of desertscrub, desert grassland, and oak woodlands. It lives in the lower elevations of the Santa Catalina Mountains and occurs over most of eastern Arizona (Lowe 1964). The only previous Late Pleistocene and Early Holocene records of this lizard are from New Mexico (Van Devender and Worthington 1977).

Holbrookia texana—Greater earless lizard

Material.—R & L dentaries (2; 11401); R maxilla (11395).

Remarks.—Teeth of *H. texana* are relatively taller on a deeper dentary than those of the smaller *H. maculata.* Dentaries of *Holbrookia* have a closed but not fused Meckel's canal. Today this lizard is found in open habitats on the south side of the Santa Catalina Mountains, but not near the cave at present. This insectivorous lizard lives at middle elevations in west central and southern Arizona, avoiding extreme desert lowlands (Stebbins 1966, Lowe 1964). The only other known Late Pleistocene or Early Holocene records of this lizard are from New Mexico (Van Devender and Worthington 1977).

Callisaurus draconoides—Zebra-tailed lizard

Material.—L dentaries (2; 11386).

Remarks.—Teeth and dentaries of *Callisaurus draconoides* are similar to those of most medium-sized sceloporine lizards and to *Holbrookia* in particular, but they can be differentiated using an ontogenetic size series of specimens. Dentaries and teeth of *Callisaurus* are much larger and more robust than those of species of *Holbrookia*; osteologically *Callisaurus* is most similar to *H. texana.* The anterior one third of the *Callisaurus* dentary is very slender and has a more medial, internal, orientation to Meckel's canal, as compared to the more ventral orientation of either *Holbrookia* or *Sceloporus.* The Zebra-tailed lizard lives in regions of fairly open sandy or gravelly, low-elevation, desertscrub communities. The nearest population to Deadman Cave is in the low areas near Florence Junction and along the San Pedro River. This is the first Late Pleistocene-Early Holocene record of *C. draconoides.*

Crotaphytus collaris—Collared lizard

Material.—R & L dentaries (6; 11390); R & L maxillae (8; 11391); pterygoid (11392); frontal (15003).

Remarks.—Specimens of *C. collaris* and *C. wislizeni* (Leopard lizard) can be separated from most other iguanid lizards by their overall larger size, and the tendency for the teeth to be pointed and recurved, an adaptation for their carnivorous habits. The teeth of *C. collaris* are relatively wider anteroposteriorly than those of *C. wislizeni,* with the posterior teeth strongly tricuspid and the anterior teeth being more like blunt cones with a slight posterior curve. Both the pterygoid and the frontal are more rugose on *C. collaris* than they are on *C. wislizeni.*

We use the name *Crotaphytus collaris* (*sensu lato*) and have not tried to separate *C. collaris* from *C. insularis* (Smith and Tanner 1972, Montanucci et al. 1975). Collared lizards can be found in all mountainous regions of southern Arizona and occasionally on open flat terrain (Lowe 1964). It presently lives near Deadman Cave.

The Collared lizard is known from fossil sites in Arizona (Van Devender and Mead 1978, Mead 1981, Cole and Mead 1981), Nevada (Brattstrom 1954*a*, Mead et al. 1982), New Mexico (Holman 1970, Gehlbach and Holman 1974, Van Devender and Worthington 1977).

Sceloporus cf. *S. clarkii*—Clark's spiny lizard

Material.—L dentaries (2; 11396); R & L maxillae (2; 11397).

Sceloporus cf. *S. magister*—Desert spiny lizard

Material.—R & L dentaries (2; 11398).

Sceloporus clarkii or *magister*—Clark's or Desert spiny lizard

Material.—R & L dentaries (10; 11400); R & L maxillae (9; 11399).

Remarks.—Osteologically it is difficult to distinguish these two moderately large spiny lizards in their southeastern Arizona range. *Sceloporus magister* can have more robust dental characters. It usually inhabits the low deserts but will occur up into the desert–grassland. *Sceloporus clarkii* lives in woodlands in Arizona, but is a common inhabitant in the subtropical thornscrub in Sonora, Mexico. Both species are found today in the Santa Catalina Mountains. Other Late Pleistocene and/or Early Holocene records of Clark's spiny lizard are in New Mexico (Van Devender and Worthington 1977) and Rancho la Brisca, Sonora, Mexico (Van Devender et al. in press). *Sceloporus magister* is fairly common in the fossil record, including Arizona (Van Devender and Mead 1978, Mead 1981), California (Brattstrom 1953*a, b*), and New Mexico (Van Devender and Worthington 1977).

Sceloporus cf. *S. undulatus*—Eastern fence lizard

Material.—R & L maxillae (3; 11387); R dentaries (2).

Remarks.—These specimens are from a small species of *Sceloporus* similar to either *S. undulatus* or *S. occidentalis* (Western fence lizard). They can be distinguished from juvenile *S. magister* or *S. clarkii* by their more slender, taller teeth. Maxillae and dentaries are less rugose in the Fence lizard, but are larger in all aspects than the *S. graciosus* (Sagebrush lizard). We are not convinced that *S. undulatus, S. occidentalis,* or *S. virgatus* (Striped Plateau lizard) can be reliably separated satisfactorily on skeletal fragments.

Sceloporus undulatus presently occurs near the cave, while *S. occidentalis* and *S. graciosus* occur farther north and *S. virgatus* occurs in southeasternmost Arizona. For this reason the material may be referred to *S. undulatus.* The Eastern fence lizard habitat in Arizona ranges from forested mountains down into the desert-grassland.

Remains of *S. undulatus* are known from Late Pleistocene and Early Holocene deposits in Arizona (Van Devender and Mead 1978, Mead 1981, Cole and Mead 1981) and New Mexico (Holman 1970, Van Devender and Worthington 1977).

Urosaurus ornatus—Tree lizard

Material.—L dentary (11402).

Remarks.—*Urosaurus ornatus* may be differentiated from most small iguanids including *U. graciosus* (Long-tailed Brush lizard) by its more slender teeth and the presence of a small fused area of the Meckel's canal. The Tree lizard in Arizona occurs in a wide variety of habitats from low, hot deserts up to open pine-oak woodlands. Late Pleistocene–Early Holocene remains of the Tree lizard have been found in southwestern New Mexico (Van Devender and Worthington 1977). The Deadman Cave specimen is the first fossil record for the species in Arizona.

Phrynosoma douglassi—Short-horned lizard

Material.—R & L dentaries (6; 11385); R & L maxillae (8; 11384).

Phrynosoma modestum—Round-tailed horned lizard

Material.—R dentary (11382); L maxilla (11383); parietal (3; 15004–15006).

Phrynosoma solare—Regal horned lizard

Material.—Parietal (11381); angular (15007); squamosal (15008).

Remarks.—Species of *Phrynosoma* can be differentiated from one another by most bones of the skull, especially those which bear horns (*see* Figs. 1–8 in Reeve 1952). The dentary, maxilla, and parietal are very rugose in *P. modestum* and are easily differentiated from the similar species, *P. platyrhinos* (Desert horned lizard), which lacks rugosity. Size, shape, and ornateness will differentiate *P. solare* from other species (*see* also Reeve 1952).

Phrynosoma douglassi presently occurs in the higher forests, woodlands, and grassland habitats in eastern Arizona and the Santa Catalina Mountains, whereas, *P. solare* lives in the Sonoran Desert valleys and bajadas, and adjacent desert-grasslands. *Phrynosoma modestum* is a characteristic Chihuahuan Desert animal found in desertscrub and desert-grassland habitats. Today it occurs no further west than Sulphur Springs Valley, 95 km east of the San Pedro River Valley. This is the first fossil record for *P. solare*; *Phrynosoma modestum* is recorded from New Mexico (Van Devender and Worthington 1977); *P. douglassi* is recorded from New Mexico (Gehlbach and Holman 1974, Van Devender and Worthington 1977) and Nevada (Mead et al. 1982).

Family Teiidae—Teiid lizards
Cnemidophorus species—Whiptail lizard

Material.—L dentary (11389); L maxilla (11388).

Remarks.—Neither the dentary nor the maxilla allowed for specific identification. Five species of Whiptail lizards occur in southern Arizona (*C. burti, C. exanguis, C. arizonae, C. inornatus,* and *C. tigris*).

Family Helodermatidae—Beaded lizards
Heloderma suspectum—Gila monster

Material.—Vertebra (11393).

Remarks.—Vertebrae of *Heloderma* can be separated from the only other large lizard of comparable size in Arizona, *Sauromalus obesus* (Chuckwalla), because they lack zygantra and zygosphenes and the dorsal half of the cotyle is oval rather than subsquare to orbicular.

The Gila monster occurs in Arizona from the southern half of the state north into the extreme northwestern corner. Living primarily in the lowlands of the Sonoran Desert and portions of the Mohave Desert, the venomous Gila monster also occurs less commonly in desert-grasslands, and rarely in the oak woodlands. *Heloderma suspectum* is common along the lower portions of the Santa Catalina Mountains but probably does not occur today at Deadman Cave.

It is not known whether the Gila monster occurred in Arizona, California, and Nevada during the Late Wisconsinan glacial or if it was a Holocene immigrant from the Sonoran Desert lowlands in the Lower Colorado River Valley around the head of the Gulf of California in Sonora, Mexico. Inadequately dated Late Pleistocene-Holocene remains occur at Vulture Cave, Arizona, and Gypsum Cave, Nevada (Mead and Phillips 1981, Brattstrom 1954*a*).

Suborder Serpentes—Snakes
Family Colubridae—Colubrid snakes
Masticophis species—Racer

Material.—Vertebrae (11; 11404).

Remarks.—The vertebrae of *Masticophis* are similar to those of *Coluber* (Racer) and *Salvadora* (Patch-nosed snake) (*see* the remarks under the latter species). *Masticophis* may be identified by the following: 1) the cotyle-condyle length (cl) is up to 6.5 mm, occasionally to 8.2 mm, 2) the ratio of the cotyle-condyle length in relation to the neural arch width (NAW) is between 1.48 and 1.75, 3) the accessory process is long, pointed, and mostly oblique to anterior, and 4) the ratio of the distance between the prezygapophyses (PR-PR) and that distance between the prezygapophysis and the postzygapophysis (PR-PO) is between 0.87 and 1.00. This same ratio for *Coluber* is 0.98 to 1.25 (Auffenberg 1963).

Snakes of the genus *Masticophis* are large, active, diurnal predators. Within the genus, identification to species is difficult; the vertebrae of *Coluber constrictor* (Blue Racer) are similar as well. *Masticophis flagellum* (Coachwhip) and *M. bilineatus* (Sonoran whipsnake) occur near Deadman Cave, while *M. taeniatus* (Striped whipsnake) occurs in the mountains to the north and northeast. Late Wisconsinan and Early

Holocene remains of *Masticophis* species are known from New Mexico (Van Devender and Worthington 1977), Arizona, and California (Van Devender and Mead 1978), Nevada (Mead et al. 1982) and from the interglacial age Rancho la Brisca, Sonora, Mexico (Van Devender et al. in press).

Salvadora species—Patch-nosed snake

Material.—Vertebrae (3; 11405).

Remarks.—The vertebrae of *Salvadora* are similar to those of *Coluber* and *Masticophis.* All generally have thin dorsal spines, a well-defined, thin haemal keel, and a tendency for epizygapophyseal spines. *Salvadora* is different from the latter two species in having a relatively smaller neural canal and a smaller condyle (Holman 1962). We do not know of any vertebral characters that unequivocally separate the two species within this genus. Snakes of the genus *Salvadora* are small ground dwellers. *S. grahamiae* (Mountain patch-nosed snake) occurs in the mountains of southeastern Arizona in oak woodlands and above, whereas *S. hexalepis* (Desert patch-nosed snake) is widely distributed in southern and western Arizona, living below the chaparral and woodland edge. Both species live in the Santa Catalina Mountains. The genus was recovered from the inter-glacial deposit at Rancho la Brisca, Sonora, Mexico (Van Devender et al. in press) and from a Late Wisconsinan-Early Holocene cave deposit in New Mexico (Van Devender and Worthington 1977).

Arizona elegans—Glossy snake

Material.—Vertebrae (9; 11413).

Remarks.—Characters used to identify the vertebrae of *A. elegans* are: 1) the cl is up to 3.5 mm, 2) the ratio of cl and NAW is between 1.08 and 1.25, 3) the high neural arch, 4) the neural spine is high and moderately thin, 5) there is a long thin accessory process which is rounded and oblique to the anterior, and 6) the cotyle is oval to subround (Van Devender and Mead 1978). This medium-sized nocturnal snake lives in deserts and grasslands of most of the Southwest as well as in northern Mexico. This snake is known from Late Wisconsinan and Early Holocene remains in New Mexico (Van Devender and Worthington 1977) and Arizona (Van Devender and Mead 1978).

Pituophis melanoleucus—Bull or Gopher snake

Material.—Vertebrae (10; 11418).

Remarks.—Criteria for identification are discussed in Auffenberg (1963), but those used here are: 1) the cl is up to 7.5 mm, 2) the cl/NAW ratio between 1.07 and 1.17, 3) the neural arch is very high with the neural spine being high and thick, 4) the zygosphene is moderately or strongly convex from the anterior, 5) the accessory processes are short, pointed or blade-like, and 6) the cotyle is round, relatively large, and only slightly oblique (Van Devender and Mead 1978). *Pituophis melanoleucus* is a widespread North American snake that lives in a wide variety of habitats in Arizona up to about 3000 m (9900 ft). Fossils of the species are found in Arizona (Van Devender et al. 1977, Van Devender and Mead 1978, Mead 1981, Cole and Mead 1981), California (Brattstrom 1953*a*), Nevada (Brattstrom 1958, 1976, Mead et al. 1982), and New Mexico (Van Devender and Worthington 1977).

Lampropeltis getulus—Common king snake

Material.—Vertebrae (7; 11416).

Remarks.—For the species identification characters, see *L. pyromelana.* Fossils of *L. getulus* are known from Arizona (Van Devender et al. 1977, Van Devender and Mead 1978, Mead and Phillips 1981, Mead 1981), California (Brattstrom 1976, Van Devender and Worthington 1977).

Lampropeltis pyromelana—Sonoran mountain kingsnake

Material.—Vertebrae (8; 11417).

Remarks.—The haemal keel and subcentral ridges are well developed in the kingsnakes. *Lampropeltis getulus* is a large species and has a sharp neural spine with relatively blunt accessory processes. *Lampropeltis pyromelana* is a small species and has a thin, low neural spine and has short, pointed accessory processes. Both species occur in the Santa Catalina Mountains. *L. getulus* is common over most of North America, whereas *L. pyromelana* is found in montane habits in Nevada, Utah, and south into Mexico. Fossil remains have been reported from New Mexico (Van Devender and Worthington 1977) and Nevada (Mead et al. 1982).

Rhinocheilus lecontei—Long-nosed snake

Material.—Vertebrae (22; 11419).

Remarks.—Although vertebrae of *R. lecontei* superficially resemble those of *Lampropeltis getulus,* they are readily distinguished using the following criteria: 1) the cl is up to 3.0 mm, 2) the ratio of the cl and the NAW is between 1.07 and 1.21, 3) the neural spine is often flat-topped, 4) the zygosphene is often flat from the anterior, 5) the accessory process is blunt, lateral or dorsal from the anterior, 6) the cotyle is round and narrower than the zygosphene, and 7) the subcentral ridges are well-developed, but less so than in *Lampropletis getulus* (Auffenberg 1963, Hill 1971, and Van Devender and Mead 1978). This medium-sized, nocturnal snake is widespread in desert, grassland, subtropical thornscrub habitats in the Southwestern U.S. and northern Mexico. The snake probably occurs near the cave today. Late Pleistocene–Holocene fossils occur in New Mexico (Van Devender and Worthington 1977), Arizona and California (Van Devender and Mead 1978, Mead 1981) and Nevada (Mead et al. 1982).

Gyalopium canum—Western hook-nosed snake

Material.—Vertebra (11414).

Remarks.—Vertebrae of *Gyalopium canum* are small but very broad for their length. The haemel keel is poorly developed and the cotyle and condyle are relatively large compared to those of *Sonora semiannulata* (Ground snake) and *Chionactis occipitalis* (Banded sand snake).

The Western hook-nosed snake is a small snake that lives in the desertscrub and desert-grasslands from southeastern Arizona to Trans-Pecos, Texas and south into the Chihuahuan Desert of Mexico. Presently it occurs no closer to Deadman Cave than the Santa Rita Mountains, 80 km to the south. The only previous fossil record of the species (as *Ficimia cana*) was from New Mexico (Van Devender and Worthington 1977).

Trimorphodon biscutatus—Lyre snake

Material.—Vertebrae (105; 11420).

Remarks.—Criteria for the identification of *T. biscutatus* are as follows: 1) the cl is up to 4.5 mm, 2) the cl/NAW ratio is between 1.08 and 1.25, 3) the neural arch is flattened, 4) the neural canal is relatively small, 5) the zygosphene is relatively small, 6) the accessory process is short and pointed, 7) the cotyle is oval to subround, strongly oblique, narrower than the zygosphene, and 8) the haemal keel is well-developed but low (Van Devender and Mead 1978). The Lyre snake is a medium-sized species that lives in desertscrub habitats in the Southwest and northern Mexico. It is found near Deadman Cave today. Fossils occur in New Mexico (Van Devender and Worthington 1977), Arizona, and California (Van Devender and Mead 1978).

Hypsiglena torquata—Night snake

Material.—Vertebrae (12; 11403, 11415).

Remarks.—Criteria for identification are as follows: 1) the cl is between 1.65 and 2.75 mm, 2) the cl/NAW ratio is 1.18 to 1.31, 3) the neural arch is moderately depressed from the posterior, 4) the neural spine is low, usually with the dorsal edge thickened and the anterior corner is bifurcate, 5) the accessory process is lateral from the anterior, and 6) the cotyle is relatively small (Van Devender and Mead 1978). The Night snake is widespread in desert, grassland, and woodland habitats in the Southwestern U.S. and northern Mexico. It occurs today near Deadman Cave. Fossils are known from New Mexico (Van Devender and Worthington 1977), Arizona and California (Van Devender and Mead 1978, Mead 1981), Nevada (Mead et al. 1982), and Rancho la Brisca, Sonora, Mexico (Van Devender et al. in press).

Family Viperidae (= Crotalidae)—Pit vipers
Crotalus atrox—Western diamondback rattlesnake

Material.—Vertebrae (5; 11406).

Remarks.—The thoracic vertebrae of the Viperidae are distinct from those of the Colubridae and Boidae in that they have a long, pointed hypophysis. The fossil vertebrae are from a large rattlesnake resembling *C. atrox*; other rattlesnakes in Arizona generally do not attain its size, except for some *C. molossus* (Blacktailed rattlesnake). Both species occur near Deadman Cave. *Crotalus atrox* is a large desert species usually occuring in the lower valleys, whereas, *C. molossus* is a woodland-dwelling species that is occasionally found in rocky habitats in more xeric desert mountain ranges. Late Pleistocene fossils of *C. atrox* have been reported from Gypsum Cave, Nevada (Brattstrom 1954*a*, *b*) and Conkling Cavern, Shelter, Fosbert (Brattstrom 1964) and Dry caves, New Mexico (Holman 1970). There are no unequivocal records of fossil *C. atrox* from Arizona; however, there is the interglacial record from Rancho la Brisca, Sonora, Mexico (Van Devender et al. in press).

Crotalus scutulatus—Mohave rattlesnake

Material.—Vertebrae (3; 11407).

Remarks.—The fossil vertebrae are from a medium-sized rattlesnake that is smaller than *Crotalus atrox* or *C. molossus.* The vertebrae of *C. viridus cerberus* (Arizona black rattlesnake), a common snake in the oak woodland, differ from those of *C. scutulatus* in their relative size of the hypophysis (*see* also Brattstrom 1964*b*). The vertebrae of *C. cerastes* (Sidewinder), *C. lepidus* (Rock rattlesnake), *C. pricei* (Twin spotted rattlesnake), and *C. willardi* (Ridgenosed rattlesnake) are smaller and differ in various morphological characters. The Mohave rattlesnake is a common desert-grassland and desertscrub snake in southern Arizona and near Deadman Cave today. Fossils of *C. scutulatus* have not been reported previously.

Class AVES—Birds
Order GALLIFORMES—Gallinaceous birds
Family Phasianidae— Pheasants, quails, etc.
Colinus gambelii—Gambel's quail

Material.—Complete carpometacarpus (15313).

Remarks.—This specimen is much smaller than the carpometacarpi of *C.* ("*Oreortyx*") *pictus* (Mountain quail) or *Cyrtonyx montezumae* (Harlequin quail), and is slightly smaller than that in *C.* ("*Callipepla*") *squamata* (Scaled quail). It differs from *C. squamata* and *C. virginianus* (Bobwhite) in having the Os metacarpale minus (metacarpal III) more slender and more curved in caudal aspect, and in having a slightly smaller Processes extensorius. This is only the second fossil occurrence of *C. gambelii,* the other being from the Early Pleistocene (Irvingtonian) of Vallecito Creek, California (Howard 1963). Brodkorb (1964) listed *C. gambelii* questionably from Conkling Cavern and Shelter Cave, New Mexico. These assignments conflict, however, with the original references, as Howard and A. H. Miller (1933) reported "*Lophortyx* sp. Quail" (sic) from these two sites. Gambel's quail lives today in the vicinity of Deadman Cave, but is approximately at its upper elevational limit.

Colinus species—quail

Material.—Proximal and distal ends of humeri (15009).

Remarks.—Among quail of the Southwest, these specimens are smaller than the humeri of *Colinus* ("*Oreortyx*") *pictus* or *Cyrtonyx montezumae.* We cannot, however, distinguish them from humeri of *Colinus virginianus, C.* ("*Lophortyx*") *gambelii,* or *C.* ("*Callipepla*") *squamata,* any of which could have occurred at Deadman Cave. Although species-level identifications are often very difficult, quail of the genus *Colinus* are common as Pleistocene fossils in southern North America, especially Florida, New Mexico, and California.

Cyrtonyx montezumae—Harlequin quail

Material.—Proximal end with partial shaft of radius (15010).

Remarks.—This specimen is larger than the radius in all other southwestern quail except *Colinus pictus.* It is referable to *Cyrtonyx* by the less expanded articulating surface of the proximal end relative to the width of the shaft. The only other fossil occurrence of *C. montezumae* is at San Josecito Cave, Nuevo Leon, Mexico (L. Miller 1943), also of Late Pleistocene age. Today the Harlequin quail occurs in grassy mountain woodlands of central and southeastern Arizona, thence ranging south well into Mexico. This species is very characteristic of evergreen oak grassland and is at its lower elevational limit near Deadman Cave today. With the historical reduction of grass and increase in brush at mid-elevations in Arizona mountains, this once common bird has decreased in abundance.

Order COLUMBIFORMES—Pigeons and doves
Family Columbidae—Pigeons and doves
Zenaida cf. *Z. macroura*—Mourning dove

Material.—Proximal end of carpometacarpus (15011).

Remarks.—This fossil differs markedly in size from the carpometacarpi of all Arizona columbids except *Zenaida macroura* and *Z. asiatica* (White-winged dove). It is tentatively assigned to *Z. macroura* in being slightly smaller than all available specimens of *Z. asiatica.* This is the first Pleistocene record of *Z. macroura* in Arizona, although this species is a fairly common Late Pleistocene fossil elsewhere in North America. The Mourning dove is very widespread in Arizona, both geographically and altitudinally, and thus is of little paleoecological interest.

Order STRIGIFORMES—Owls
Family Strigidae—Typical owls
Otus species—Screech-owl

Material.—Two proximal ends and one distal end of humeri (3; 15012), proximal end of carpometacarpus (15013).

Remarks.—These specimens all agree in size and morphology with *Otus asio* (Common screech-owl), and are either larger or smaller than in all Arizonan owls outside of the genus *Otus.* The carpometacarpus and one proximal end of humerus are slightly larger than in *O. flammeolus* (Flammulated screech-owl), but the other elements resemble both *O. asio* and *O. flammeolus.* No skeleton was available for *O. trichopsis* (Spotted screech-owl), so identification beyond generic level is not possible. These three species of *Otus* in Arizona are largely separated from each other today by habitat and elevation, and it seems most likely that *O. asio* or *O. trichopsis* would have lived near Deadman Cave in the Late Pleistocene. Probably only *O. asio* occurs in the immediate vicinity of Deadman Cave today. *Otus asio* is a common Late Pleistocene fossil in

North America, while *O. flammeolus* and *O. trichopsis* have only two and one Pleistocene records, respectively. This is the first fossil record of *Otus* in Arizona.

Micrathene whitneyi—Elf owl

Material.—Proximal end of humerus (15014), distal end of tarsometatarsus (15015).

Remarks.—The Elf owl is readily separated from all other owls by its extremely small size. This is the first Pleistocene record for *M. whitneyi.* It occurs today in the region of Deadman Cave, nesting in holes in trees at any elevation "below the heavy pine forest" (Phillips et al. 1964).

Asio otus—Long-eared owl

Material.—Distal end of humerus (15016).

Remarks.—This fossil agrees with the humerus of *Asio otus* versus *A. flammeus* (Short-eared owl) in having a distinctive knot-like ectepicondylar prominence (Processes supracondylaris dorsalis). *Asio otus* is a fairly common Late Pleistocene fossil in western North America, but this is the first such record in Arizona. The Long-eared owl is not unexpected at Deadman Cave, as it occurs today in Arizona in a variety of habitats, both as a nesting bird and a winter visitor. As mentioned above, *A. otus* probably was involved in the accumulation of small vertebrates in Deadman Cave.

Order CAPRIMULGIFORMES—Goatsuckers, etc.
Family Caprimulgidae—Night jars
Genus and species indeterminate

Material.—Carpometacarpus lacking distal end and much of metacarpal III (15017).

Remarks.—This carpometacarpus is distinguished from that of *Chordeiles minor* (Common nighthawk) and *C. acutipennis* (Lesser nighthawk) by its much smaller size, and from *Caprimulgus vociferus* (Whip-poor-will) by its slightly smaller overall size with a more slender metacarpal III. It resembles that of *Phalaenoptilus nuttallii* (Poorwill) very closely, but the shape of metacarpal I is somewhat more similar to that in *Caprimulgus.* In the absence of a comparative skeleton of *Caprimulgus ridgwayi* (Ridgeway's whip-poor-will), the only other caprimulgid living in Arizona, precise identification of this fossil is impossible. The Pleistocene record of caprimulgids is poorly known everywhere. This is the first fossil record for the family in Arizona.

Order PICIFORMES—Woodpeckers, etc.
Family Picidae—Woodpeckers
Colaptes auratus—Flicker

Material.—Distal end of tarsometatarsus (15018).

Remarks.—Among Arizonan woodpeckers, the tarsometatarsus of *Colaptes auratus* is similar in size only to that of *Melanerpes* ("*Asyndesmus*") *lewis* (Lewis' woodpecker). The fossil agrees with *C. auratus* versus *M. lewis* in its larger, less deeply sculptured middle trochlea. The distal end of the tarsometatarsus in the "Red-shafted" flicker (*C. a. collaris*) appears to be indistinguishable from that in the "Gilded" flicker (*C. a. mearnsi*). Thus the fossil provides no evidence of paleohabitats near Deadman Cave. *C. a. collaris* is a bird of mountain woodland and forest, ranging upward from approximately 1220 m elevation, whereas *C. a. mearnsi* occurs in desertscrub, generally below 1370 m elevation. Based on the remainder of the avifauna, one would guess that the Late Pleistocene flicker at Deadman Cave was *C. a. collaris,* although both forms occur in the general region of the site today. Flickers are very common Late Pleistocene fossils, yet once again this is the first such record for Arizona.

Order PASSERIFORMES—Perching birds
Family Turdidae—Thrushes
Turdus cf. *T. migratorius*—American robin

Material.—Proximal end of humerus (15019).

Remarks.—The humerus of *Turdus migratorius* can be told from that of most other North American turdids by its larger size. It can be recognized from that in *Ixoreus naevius* (Varied thrush) by its stouter Crus dorsalis fossae which, along with the deeper dorsal Fossa pneumotricipitalis, also distinguishes it from the humeri of mimids (thrashers, mockingbirds). The humerus of *T. migratorius* can be separated from that in the neotropical *T. grayi* (Clay-colored robin) reported from Stanton's Cave, Coconino County, Arizona (Rea and Hargrave, ms) by its lesser degree of pneumaticity in both the dorsal and ventral Fossa pneumotricipitalis, the former also being larger in *T. grayi*. The fossil differs from the only available humerus of *T. rufopalliatus* (Rufous backed robin, a vagrant to Arizona today; resident in Sonora) in having a larger and more oblong (less circular) opening of the ventral Fossa pneumotricipitalis. Lacking additional specimens of *T. rufopalliatus* to confirm this character, no more than a tentative assignment of the fossil to *T. migratorius* is warranted. *T. migratorius* is a common Late Pleistocene species in much of North America, and has been reported in Arizona from Stanton's Cave (Rea and Hargrave, ms). The American robin is common in Arizona today, nesting throughout the state in wooded regions above approximately 1220 m elevation.

Catharus guttatus—Hermit thrush

Material.—Distal end of humerus with most of shaft (19020).

Remarks.—The humerus of *Catharus guttatus* is smaller than in mimids and in the following species of turdids: *Hylocichla mustelina* (Wood thrush), *Ixoreus naevius, Myadestes townsendi* (Townsend's solitaire), and all species of *Turdus*. It is larger and has a stouter Corpus humeri (shaft) than in *T. ustulatus* (Swainson's thrush). It is approximately equal in size to that of *C. fuscescens* (Veery), *C. minimus* (Gray-cheeked thrush), and the species of *Sialia* (bluebirds), but is told from these and all other Arizona turdids by having a relatively smaller Processus supracondylaris dorsalis, this being particularly evident in dorsal aspect, where P dorsalis is seen not to extend as far proximally in *C. guttatus* as in other species.

This is the first fossil record anywhere for *C. guttatus*. Brodkorb (1978) listed *C. guttatus* from the Late Pleistocene site of Carpinteria, California, citing A. H. Miller (1932*b*) as the authority. However, A. H. Miller (1932*b*) clearly did not refer the specimen in question, a humerus, to any species. Miller listed the specimen as "HYLOCICHLA? Thrush" (sic), stating that the fossil resembled *Hylocichla* (=*Catharus*) *guttata* in certain aspects, *H. mustelina* in others, and probably represented an extinct taxon of thrushes. The Hermit thrush is widespread in Arizona today, and is common in the Santa Catalina Mountains, nesting at high elevations and occurring elsewhere as a migrant or wintering bird.

Family Fringillidae—Sparrows, finches, tanagers, blackbirds, warblers, etc.
Subfamily Icterinae—Blackbirds, etc.
Genus and species indeterminate

Material.—Distal end of tarsometatarsus (15021).

Remarks.—This specimen is larger than the tarsometatarsus in all non-icterine, nine-primaried oscines of the Southwest. Among southwestern icterines, it is smaller than in *Sturnella magna* (Eastern meadowlark), *S. neglecta* (Western meadowlark), and *Cassadix mexicanus* (Boat-tailed grackle), and larger than in *Molothrus ater* (Brown-headed cowbird) or any species of *Icterus* (orioles). Of the species that it approximates in size, the fossil may be distinguished: from *Agelaius phoeniceus* (Red-winged blackbird) and *Xanthocephalus xanthocephalus* (Yellow-headed blackbird) by its more dorso-plantar expansion of the middle and inner trochleae; from *Euphagus cyanocephalus* (Brewer's blackbird) and *E. carolinus* (Rusty blackbird) by its larger intertrochlear spaces, the more dorso-plantar expansion of the inner trochlea, and the more proximo-distally expanded outer trochlea; and from *Molothrus aeneus* (Bronzed cowbird) by its slightly wider outer intertrochlear space and slightly more laterally compressed inner trochlea. Overall, this specimen seems to be more similar to the tarsometatarsus of *Molothrus aeneus* than to any other living icterine, but is not similar enough to be referred confidently to that species.

The fossil icterine from Deadman Cave may represent an extinct taxon. Four species of extinct icterines have been described from rostra and mandibles from Late Pleistocene sites in North America. These are *Pandanaris convexa* (A. H. Miller 1947), and *Euphagus magnirostris* (A. H. Miller 1929), both from Rancho La Brea, California; *Pandanaris floridana* (Brodkorb 1957) from Reddick and Haile XIB, Florida; and *Pyeloramphus molothroides* (A. H. Miller 1932*a*) from Shelter Cave, New Mexico. Referred post-cranial elements have been reported for *Pandanaris floridana* and *Euphagus magnirostris,* but we have not examined this material. All Late Pleistocene icterines are in need of re-study (Steadman and Martin, in press), and pending such work the specimen from Deadman Cave is best left unidentified. Nevertheless, it may represent a new faunal element for Arizona.

Subfamily Emberizinae—"New World" sparrows, finches, etc.
Genus and species indeterminate

Material.—Tarsometatarsus lacking proximal end (15022).

Remarks.—Postcranial emberizine fossils are often very difficult or impossible to identify to genus or species. The present specimen is smaller than the tarsometatarsi of any icterine (blackbirds) or North American thraupine (tanagers), and is smaller than in most parulines (New World warblers). It differs from the tarsometatarsi of vireonids (vireos) in its more slender middle trochlea and broader inner trochlea, this last character also distinguishing it from the tarsometatarsi of parulines. Within the emberizines, no readily apparent patterns of tarsometatarsal variation are discernible. When compared to all species of North American emberizines, the fossil was found to be indistinguishable, both in size and quality, from the following species of medium-sized sparrows: *Ammodramus sandwichensis* (Savannah sparrow), *Melospiza lincolnii* (Lincoln's sparrow), *M. georgiana* (Swamp sparrow), *Junco hyemalis* (Dark-eyed junco), and *J. phaeonotus* (Mexican junco). Geographical and sexual variation combine to render the tarsometatarsus of these five species inseparable in many instances. Certain individuals of each species appear to be distinct, but no consistent variation is seen. Each of these species occurs today in southern Arizona, although in different habitats and in very different frequencies.

Class MAMMALIA—Mammals
Order INSECTIVORA—Insectivores
Family Soricidae—Shrews
Notiosorex crawfordi—Desert shrew

Material.—L mandible (3; 15023); R mandible (2; 15024).

Remarks.—The shape of the mandibles and the presence of three unicusps on each jaw were the identifying characters. *Notiosorex crawfordi* occurs fairly commonly as fossils in Arizona (Mead and Phillips 1981, Mead et al. 1983), New Mexico, and Texas (Harris 1977). Presently the Desert shrew occupies a wide variety of ecological situations from semi-desertscrub to woodland (Armstrong and Jones 1972). It is not known to occur at present in the Santa Catalina Mountains, but it does live nearby (Cockrum 1960).

Order CHIROPTERA—Bats
Family Vespertilionidae—Vespertilionid bats
cf. *Myotis*—Mouse-eared bat

Material.—L mandible with M_2 (15025); R mandible (3; 15027).

Remarks.—These specimens, clearly a vespertilionid based on the shape of the jaw, could not be identified unequivocally to genus because of fragmentation and/or for loss of teeth. Skinner (1942) reported *Myotis* cf. *M. velifer* (Cave myotis), *M.* cf. *M. thysanodes* (Fringed myotis), and *M.* cf. *M. evoltis* (Long-eared myotis) from Papago Springs Cave, Arizona.

Antrozous pallidus—Pallid bat

Material.—L femur (15025).

Remarks.—The greatest length of the fossil femur is 19.0 mm and the width of the proximal end is 3.0 mm (lesser trochanter to greater trochanter). A blade-like third trochanter is present. The Deadman Cave specimen was compared to *Myotis thysanodes, M. californicus* (California myotis), *M. velifer, Plecotus townsendii* (Townsend's big-eared bat), *Lasiurus borealis* (Red bat), *L. cinereus* (Hoary bat), *Macrotus waterhousei* (Leaf-nosed bat), *Tadarida brasiliensis* (Brazilian free-tailed bat), *T. femorosacca* (Pocketed free-tailed bat), *Mormoops megalophylla* (Ghost-faced bat), *Antrozous pallidus,* and *Eptesicus fuscus* (Big brown bat). Only the last two species were similar to the fossil in having a femur of total length averaging near 19.0 mm and a proximal width of 2.8 to 3.0 mm, along with the lesser trochanter as pronounced as the greater trochanter; but of these two, only *A. pallidus* had the third trochanter. The other species of bats lacked two or all of the criteria used to differentiate the fossil specimen.

The Pallid bat occurs throughout Arizona and can be found near Deadman Cave today (Cockrum 1960, Barbour and Davis 1969). Bats of the genus *Antrozous* have been recovered as fossils in a wood rat midden in the Sonoran Desert (Mead et al. 1983) and from Papago Springs Cave (Skinner 1942).

Order EDENTATA—Edentates
Family Megatheriidae—Megathere ground sloths
Nothrotheriops shastensis—Shasta ground sloth

Material.—Molar (15314).

Remarks.—Greg McDonald (Royal Ontario Museum, 1982, *personal communication*) confirmed this identification of *N. shastensis* and indicated that because the small molar contained a high percentage of hollow pulp cavity and lacked wear striations, it must have been from a fetal or new born sloth. Remains of the extinct Shasta ground sloth are very common in the Southwest, especially in Arizona (Long and Martin 1974, Thompson et al. 1980). A typographical error in Lindsay and Tessman (1974) has the sloth incorrectly located in Stanton's Cave, Grand Canyon.

Order LAGOMORPHA—Lagomorphs
Family Leporidae—Hares and rabbits
Sylvilagus species—Cottontail

Material.—L mandible; R mandibles (2); maxilla.

Remarks.—Postcranial remains of leporids were the second most common elements in the fossil deposit. The mandibles and the maxilla are not identified to species at this time because a more detailed study of all Late Pleistocene leporid remains of Arizona is in order and will be appearing in the near future (JIM). The genus is recovered from a number of Late Pleistocene localities in Arizona (Lindsay and Tessman 1974, Mead et al. 1983) and New Mexico (Harris 1977).

Lepus species—Jackrabbit

Material.—L mandibles (6); R mandibles (4); L maxillae (2); R maxillae (2); premaxilla; isolated molars (4); L femur proximal half.

Remarks.—See the remarks under *Sylvilagus. Lepus alleni* (Antelope jackrabbit) and *L. callotis* (White-sided jackrabbit) both presently occur in Arizona, but not near Deadman Cave. *L. californicus* occurs near Deadman Cave today. *Lepus californicus* (Black-tailed jackrabbit) was recovered from Papago Springs Cave (Skinner 1942) and other Arizona localities (Lindsay and Tessman 1974, Mead et al. 1983).

Order RODENTIA—Rodents
Family Sciuridae—Squirrels
Spermophilus variegatus—Rock squirrel

Material.—L mandible with M_{1-2} (2; 15028); R mandible (15029); L maxilla with M^{1-2} (15030).

Remarks.—*Spermophilus variegatus* can be differentiated from other species of ground squirrels by its larger size and the tendency of the skeleton to be slightly more rugose. The only other squirrel of similar size is *Sciurus aberti* (Abert's squirrel). The P^4 is relatively larger in *Spermophilus variegatus* as compared to that in *Sciurus.* The shape and medial inflection of the angle on the mandible is greater on *S. variegatus.* The Rock squirrel is a common ground squirrel and the largest within its distribution. It prefers rocky regions and is found throughout the Southwest, including the vicinity of Deadman Cave. Fossil remains of the Rock squirrel are not common in Late Pleistocene localities in the Southwest (Harris 1977, Mead 1981, Kurtén and Anderson 1980), although Skinner (1942) identified three mandibular rami of *S.* (=*Citellus*) *variegatus* from Papago Springs Cave.

Family Geomyidae—Pocket gophers
Thomomys cf. *T. bottae*—Bottae's pocket gopher

Material.—L & R maxillae (3; 15036); isolated teeth (9; 15037); R humerus (15038).

Remarks.—The upper incisors were lacking any conspicuous longitudinal groove, and the maxillary and isolated cheek teeth all were the lobbed, simple hypsodont molars and premolars of *Thomomys.* We follow Thaeler (1968) in using the designation *T. bottae,* which is the *T. umbrinus* of Hall (1981). The former species is common today in the Santa Catalina Mountains, and therefore, the reason for our identification of the fossils. The genus is a common fossil recovered in the Southwest (Mawby 1967, Lindsay and Tessman 1974, Harris 1977).

Family Heteromyidae—Pocket mice and Kangaroo rats
Perognathus cf. *P. flavus*—Silky pocket mouse

Material.—R maxillae (3; 15032); L maxillae (2; 15033); R mandibles (3; 15034); L mandibles (4; 15035).

Remarks.—The pocket mouse specimens from Deadman Cave compare well with *P. flavus,* although two other indistinguishable, small pocket mice, *P. parvus* (Great Basin pocket mouse) and *P. flavescens* (Plains pocket mouse) could also be in the assemblage. Our tentative identification is based on the present geographic distributions. Complete skulls are needed for unequivocal identification. *Perognathus flavus* lives near Deadman Cave region. The only other Late Pleistocene occurrence of this mouse is from Isleta Cave, New Mexico (Harris and Findley 1964).

Dipodomys spectabilis—Banner-tailed kangaroo rat

Material.—Bacculum (15031).

Remarks.—The shape of the bacculum of *Dipodomys spectabilis* is distinct from that of all other species. *Dipodomys spectabilis* is a large kangaroo rat that inhabits the desert-grasslands of southeastern Arizona, including the valleys below the Santa Catalina Mountains (Cockrum 1960, Hall 1981). Harris (1977) has reported fossils of *D. spectabilis* from southern New Mexico.

Family Cricetidae—New World Rats and Mice
Reithrodontomys montanus—Plains harvest mouse

Material.—L mandible (15041); R mandibles (3; 15042).

Remarks.—The mandibles and teeth of the harvest mice from Deadman Cave compare favorably with those of *R. montanus.* The other harvest mice in Arizona, *R. megalotis* (Western harvest mouse) and *R. fulvescens* (Fulvous harvest mouse), are both larger than *R. montanus.* The occlusal pattern of the molar of *R. fulvescens* is an "S" configuration as opposed to a "C" in *R. montanus* (Hooper 1952).

Reithrodontomys montanus occurs today in the grasslands of southeastern Arizona but not in the Santa Catalina Mountains. The other two species occur in a wider variety of communities (Cockrum 1960). Fossil occurrences are discussed in Kurtén and Anderson (1980).

Peromyscus species—Deer mouse

Material.—L mandibles (4); R mandibles (4).

Remarks.—Fragments of *Peromyscus* can be confused with those of *Reithrodontomys.* The following characters will separate the two genera: 1) the M_3 is relatively larger on *Peromyscus,* 2) the articular condyle of the mandible extends more posteriorly than does the angle, on *Peromyscus,* and 3) the angle of the mandible has a less medial inflection on *Peromyscus.* We were unable to identify these specimens to species. Eight species of *Peromyscus* occur in southern Arizona, thus species level identification of fossils is extremely difficult if not impossible. Fossils of the genus have been recovered from all over the Southwest (Harris 1977, Kurtén and Anderson 1980, Mead et al. 1983).

Sigmodon species—Cotton rat

Material.—R mandible with M_{1-3} (15039); R maxilla with M^{1-2} (15040).

Remarks.—The occlusal pattern on all cheek teeth are distinct in *Sigmodon.* We are not able to identify our specimens to species. Four species of cotton rat now inhabit southern Arizona (Hall 1981). *Sigmodon hispidus* (Hispid cotton rat) occurs on the western and eastern borders of southern Arizona while *Sigmodon arizonae* (Arizona cotton rat) lives in the area of the Santa Catalina Mountains. Both *S. fulviventer* (Tawny-bellied cotton rat) and *S. ochrognathus* (Yellow-nosed cotton rat) occur south and east of Deadman Cave (Baker and Shump 1978*a, b,* Hall 1981). *S. ochrognathus* was recovered from a wood rat midden near the Santa Catalina Mountains (Mead et al. 1983). The genus has a rich fossil record throughout the Southwest (Lindsay and Tessman 1974, Harris 1977).

Neotoma albigula—White-throated wood rat

Material.—L mandibles (3); R mandibles (4); L maxillae (3); R maxillae (7); LM_1 (7); RM_1 (8); LM^1 (11); RM^1 (15); M^2_2 (55); M^3_3 (15).

Remarks.—All the *Neotoma* remains compare well with *N. albigula.* The occlusal patterns for adult teeth are well-rounded as in *N. albigula* and *N. lepida* (Desert wood rat), but the teeth are much larger than those of modern *N. lepida.* The anterolingual re-entrant on the M_1 are very shallow as in *N. albigula* compared to the deep, microtine-like dental characters of *N. mexicana* (Mexican wood rat).

Five species of *Neotoma* presently live in Arizona (Colorado Plateau), more than in any other state. Only *N. lepida, N. albigula,* and *N. mexicana* inhabit southern Arizona today, and only the last two presently occur in the vicinity of Deadman Cave. *N. albigula* lives in desert-grassland and desertscrub habitats while *N. mexicana* occurs

TABLE 2. Measurements of modern and fossil dentaries (Deadman and Rampart caves) of *Bassariscus astutus*. Measurements are rounded to the nearest 0.5 mm.

	n	OR	$\bar{x}$
	Alveolar length P_4–M_1		
Deadman Cave	1	24.0	24.0
Modern Arizona	13	21.0–23.0	22.0
Rampart Cave, Arizona (northern)	1	27.9	27.9
	Alveolar length M_1		
Deadman Cave	1	8.0	8.0
Modern Arizona	13	6.5–7.5	7.0
Rampart Cave, Arizona (northern)	1	6.5	6.5

in higher woodland and forest areas. *Neotoma stephensi* (Stephen's wood rat) occurs in the northern half of the state and *N. cinerea* (Bushy-tailed wood rat) in the northeastern sector (Cockrum 1982). The midden of the wood rat is found in numerous dry localities throughout the Southwest and is radiocarbon dated back to more than 40 000 B.P. (Van Devender 1977, Van Devender and Spaulding 1979).

Microtus species—Meadow vole

Material.—L mandible (15043); LM_1 (2: 15044); RM_1 (15045); RM^3 (3: 15046).

Remarks.—We have not identified the fossil teeth to the specific level. We find it difficult to differentiate *M. longicaudus* (Long-tailed vole) from *M. montanus* (Montane vole) using isolated molars. Of the three complete fossil M_1s examined, two had four closed alternating triangles and one had five triangles.

None of the four species of vole found in Arizona presently occur near Deadman Cave. *Microtus mexicanus* (Mexican vole) presently occurs in the mountainous region of eastern Arizona but may have had a wider, more western distribution, based upon the present isolated occurrence of *M. m. hualpaiensis* in northwestern Arizona, in the Late Pleistocene and/or Early Holocene (Hall 1981). The Mexican vole was also identified in the fossil remains from Papago Springs Cave (Skinner 1942). *Microtus montanus* (Montane vole) has a predominantly northwestern distribution in the United States. Its nearest occurrence to Deadman Cave is in the Arizona Strip region of northernmost Arizona and in east-central Arizona. *Microtus pennsylvanicus* (Meadow vole) lives mainly in northern and eastern North America but approaches Arizona in northwestern New Mexico. The Meadow vole may have had a more southern, mountainous distribution in the Late Pleistocene or Early Holocene based upon an isolated modern population in northwestern Chihuahua, Mexico (Bradley and Cockrum 1968). *Microtus longicaudus* occurs through much of western North America, including northeastern Arizona. An isolated population presently lives in the Pinaleño Mountains only 60 km east of Deadman Cave. Based on present geographic distributions, this species seems most likely to have inhabited the mountains of the Basin-and-Range province of southeastern Arizona during the Late Pleistocene and Early Holocene.

Order CARNIVORA—Carnivores
Family Procyonidae—Racoons, coatis, and ringtails
Bassariscus astutus—Ringtail

Material.—R mandible P_{2-3} (15062); R maxilla (15315); LP^4 (15316).

Remarks.—The fossil Ringtail specimen compares well with modern specimens except that the M_2 is not developed in the fossil specimen, but is replaced by a distinct depressional scar where the tooth was to have developed. The alveolar length from P_4 to M_1 (Table 2) is slightly longer in the Deadman Cave specimen than in modern specimens. The mandible from Deadman Cave does not seem to be similar to the rami

TABLE 3. Measurements of dentaries (modern and Deadman Cave) of *Spilogale putorius.* Measurements are rounded to nearest 0.5 mm.

	n	OR	$\bar{x}$
	Alveolar length P_2–M_2		
Deadman Cave	5	15.5–18.0	16.5
Modern Arizona	7	12.5–14.5	13.5
Modern Nevada (northern)	1	15.8	15.8
	Alveolar length P^2–M^1		
Deadman Cave	1	14.0	14.0
Modern Arizona	8	11.5–13.0	12.5
Modern Nevada (northern)	1	12.0	12.0

described as *B. sonoitensis* from Papago Springs Cave (Skinner 1942). Late Pleistocene and Holocene localities of the Ringtail are shown in Mead and Van Devender (1981).

The Ringtail is widespread in rocky habitats in the desert grassland, and woodlands of the Southwest, and lives today in Deadman Cave. Numerous modern scats are located throughout the cave, especially near the entrance as demonstrated by the accumulations of seeds, insects, and bones.

Family Mustelidae—Weasels, skunks, and badgers
Spilogale putorius—Spotted skunk

Material.—L mandibles (3; 15047–15049); R mandibles (6; 15050–15055); L maxilla (15056); R maxillae (2; 15057–15058); L humerus (15059).

Remarks.—The specimens from Deadman Cave are consistently larger than modern specimens of *S. putorius* (Table 3). The Spotted skunk is common throughout the Southwest and can be found in the Santa Catalina Mountains down to the lower desert mountain ranges. Elsewhere, fossil remains of the Spotted skunk have been recovered from Arizona (Skinner 1942), California (Stock 1930), and New Mexico (Harris 1977).

Mephitis macroura—Hooded skunk

Material.—L mandibles (2; 15060); L maxilla (15061); L humerus (15317).

Remarks.—The left mandible compares most favorably with that of *Mephitis macroura,* being smaller than in *M. mephitis* (Striped skunk) or *Conepatus mesoleucus* (Hog-nosed skunk) yet definitely larger than in *Spilogale.* All three skunks occur in southern Arizona, including the Santa Catalina Mountains. *Mephitis macroura* has its present northern distribution in southern Arizona and New Mexico (Hall 1981). We know of no other Late Pleistocene–Early Holocene record of this taxon.

Family Felidae—Cats
Felis concolor—Mountain lion

Material.—LC^1 (15063); LC_1 (15064); RC_1 (15065).

Remarks.—All the canines compared well with *F. concolor* rather than *Panthera leo atrox* (American lion) which has been recovered from Late Pleistocene age deposits of the nearby Murray Springs site (Haynes 1968, J. J. Saunders *personal communication*). The canines were compared in size to those of modern Arizona Mountain lions and fossil specimens from Rancho La Brea, California, El Durado, Colorado, Tule Springs, Nevada (Kurtén 1973), and Rampart Cave, Arizona (Table 4). There were no discernible differences other than that the Late Pleistocene *Felis concolor* canines from Rancho La Brea may have been slightly larger than those from Deadman Cave.

The Mountain lion occurs historically and paleontologically throughout the Southwest, including the Santa Catalina Mountains (Hall 1981). Although it is usually found in woodlands and forest country, it also lives in rugged ranges well within the Sonoran Desert.

TABLE 4. Length (L; anterior–posterior) and breadth (B; labial–lingual) range of measurements of canines in modern and Late Pleistocene–Early Holocene Mountain lion (*Felis concolor*). Recent specimens from Arizona (44, 654, 22785, and 23444; Department of Ecology and Evolutionary Biology, University of Arizona, Tucson). Measurements (in millimeters) of fossil specimens, other than from Deadman and Rampart caves, from Kurtén (1976).

		C^1		C_1	
	$n =$	L	B	L	B
Recent Arizona	4	10.9–13.2	9.4–11.9	10.8–13.2	8.0–9.8
Deadman Cave, Arizona	3	11.3	10.3	11.0–11.3	8.2–8.6
Rampart Cave, Arizona	1	12.8	9.9	—	—
Rancho La Brea, California	3	—	—	12.4–16.4	11.2–12.5
El Dorado, Colorado	2	12.6	11.0	12.0	9.8
Tule Springs, Nevada	1	—	9.8	—	—

Order PERISSODACTYLA—Odd-toed ungulates
Family Equidae—Horses
Equus species—Horse

Material.—2nd phalanx (15027).

Remarks.—This single element of a horse could not be identified to species. Remains of extinct species of Horse are common throughout the Southwest (Stock 1930, Mawby 1967, Lindsay and Tessman 1974, Harris 1977, Harris and Porter 1980, Kurtén and Anderson 1980). Skinner (1942) identified *E. conversidens* and *E. tau* from Papago Springs Cave.

Order ARTIODACTYLA—Even-toed ungulates
Family Cervidae—Cervids
Odocoileus species—Deer

Material.—LP_2 (15066).

Remarks.—The Deadman Cave specimen of *Odocoileus* could not be identified to species. Today in southern Arizona *O. hemionus* (Black-tailed deer) lives in the lowland habitats while *O. virginiana* (White-tailed deer) is found on the mountain tops. Fossil remains of both species of deer are widespread in North America (Kurtén and Anderson 1980), although only a few Late Pleistocene localities in Arizona contain remains of deer (Lindsay and Tessman 1974, Mead 1981).

Family Bovidae—Bovids
Euceratherium collinum—Shrub-ox

Material.—L mandible (15318).

Remarks.—The single specimen of the extinct Shrub-ox was identified by Walter Dalquest and Ernest Lundelius (Dalquest 1981, *personal communication*). The occlusal surface of the teeth were very worn, indicating an old individual. This specimen is the first record of the Shrub-ox in Arizona. Kurtén and Anderson (1980) describe this bovid as a large, specialized grazer that probably lived in the lower foothills (like at Deadman Cave) rather than in the high, forested mountains. *Euceratherium collinum* is also known from Burnet Cave, New Mexico (Schultz and Howard 1935), but is not a common component of Late Pleistocene faunas in the Southwest (Kurtén and Anderson 1980).

DISCUSSION

Localities

Although there are numerous Late Pleistocene age localities in Arizona, especially in the southern portion (Lindsay and Tessman 1974), most of these sites are isolated finds in alluvial deposits containing *Mammuthus jeffersoni* (Jefferson's mammoth; =*M. columbi, fide* Kurtén and Anderson 1980), *Camelops* species (camel), *Equus* species, or *Bison* species (bison).

The most current work in Arizona concerning Late Pleistocene (Wisconsinan) age deposits comes from the well-preserved, radiocarbon dated wood rat middens, but these localities rarely contain the larger animals (Van Devender and Mead 1978, Mead 1981, Mead et al. 1983). The only cave faunas studied in southern Arizona are Papago Springs Cave (Skinner 1942) and Ventana Cave (Haury 1950). Ventana Cave (145 km west of Deadman Cave, Fig. 1) was excavated primarily for its abundant archaeological remains. Two lower units, Volcanic and Conglomerate, were deposited during the Wisconsinan glacial episode (Haury 1950). Papago Springs Cave (112 km south of Deadman Cave, Fig. 1) was excavated solely for its Late Pleistocene vertebrate fossils, which were laborously chiseled from brecciated layers along the walls and ceiling of the cave (Skinner 1942).

The two cave faunas are very different in composition (Table 1). The fourteen taxa recovered from the lower units in Ventana Cave were all mammals, whereas a bird and 32 mammals were recovered from Papago Springs Cave. Only *Canis latrans* (=*C. caneloensis*; Coyote), *Lepus californicus,* and *Taxidea taxus* (Badger) are shared in both faunas. Of the 64 taxa from Deadman Cave (5 amphibians, 25 reptiles, 12 birds, and 22 mammals), only *Nothrotheriops shastensis* is shared with Ventana Cave and five species (*Spermophilus variegatus, Thomomys* cf. *T. bottae, Neotoma albigula, Antrozous pallidus,* and *Spilogale putorius*) are shared with Papago Springs Cave. Each cave is in a different physiographic setting in southern Arizona and had different modes of fossil accumulation. Deadman Cave is a limestone cave on a large mountain mass between two major river valleys surrounded by Sonoran and Chihuahuan desertscrub communities; its fauna was collected predominantly by small carnivores and raptors. Ventana Cave is a volcanic rockshelter in a small, low-elevation desert mountain range presently surrounded by the hot, dry Sonoran Desert. The open cave provided some shelter, easy access, as well as water from a spring. Papago Springs Cave was an open limestone cave in rolling oak woodland in the Canelo Hills of southeastern Arizona.

The Late Wisconsinan age assignment of the deposition of the Volcanic and Conglomerate units in Ventana Cave is presumably correct (Haury 1950, *see* Long and Muller 1981). The fossils from Papago Springs Cave are only broadly assigned to the Late Pleistocene, but for several reasons we suggest that the Papago Springs Cave deposit was formed prior to the last glacial maximum in the Wisconsinan (>22 000 B.P.). The chamber within the cave has changed configuration greatly since the initial deposition of the fauna. A great abundance of rock rubble (10 m thick) with bones has filled the cavern and become cemented. According to Skinner (1942) the cave was sealed off from the outside for a period of time, allowing settling and cementing of the fossils to take place. A third stage in the history of the cave reopened the cavern entrances permitting recent faunal accumulations and partial erosion of the fossil deposits. We feel that such an accumulation may have required a few ten's of thousands of years, placing the time of deposition sometime in the Middle or Early Wisconsinan glacial episode.

Fauna

Five species of amphibians (all anurans) were identified from Deadman Cave (Table 1). Of these, only *Bufo punctatus* and *Scaphiopus couchi* were reported prior to this report from the Late Pleistocene and Early Holocene of Arizona. We report *Bufo* cf. *B. woodhousei, Scaphiopus* cf. *S. hammondi,* and *Rana* sp. for the first time as fossils in Arizona, although they have been previously recorded from Late Pleistocene localities in California, Nevada, and New Mexico. Except for *B. woodhousei,* all anurans from the Deadman Cave fauna are found nearby the cave today.

Reptiles are better known than the amphibians from Late Pleistocene–Early Holocene deposits in Arizona. We report 25 reptiles, including 13 species of lizards and 12 species of snakes, from Deadman Cave. Of the lizards, *Callisaurus draconoides,* *Holbrookia maculata, H. texana, Phrynosoma douglassi, P. modestum, P. solare, Sceloporus* cf. *S. clarkii,* and *Urosaurus ornatus* have not been reported previously from the Late Pleistocene of Arizona. The records of *Heloderma suspectum* from Vulture Cave, Arizona, and Gypsum Cave, Nevada, may be Early or Middle Holocene in age, and therefore this species perhaps should be added to the above list. Most of these lizards have previous fossil records from sites in California, Nevada, and/or New Mexico. *Callisaurus draconoides* is reported for the first time as a Late Wisconsinan–Early Holocene fossil. *Phrynosoma modestum* and *C. draconoides* do not presently inhabit the region of Deadman Cave nor the immediate valley. The closest occurrence of *P. modestum* is in Chihuahuan desert-grassland 95 km east of the cave. *Callisaurus draconoides* occurs just west of Deadman Cave in lower Sonoran desertscrub. The other lizards from Deadman Cave, as well as most of the snakes, now live within a raptor's hunting range of the fossil locality. Of the 12 species of snakes identified from Deadman Cave, only *Gyalopium canum* has not been previously reported as a fossil from Arizona, and is out of its present distributional range at Deadman Cave.

The birds from Deadman Cave represent only the fifth Late Pleistocene avifauna to be reported from Arizona. This contrasts markedly with the adjacent states of New Mexico and California, each of which has an excellent record of Late Pleistocene birds. The Deadman Cave avifauna is especially significant in that the diverse Sonoran Desert avifauna has yielded very few Pleistocene fossils.

The Deadman Cave fauna contains several new avian fossil records, none of which is unexpected. *Micrathene whitneyi* and *Catharus guttatus* are reported for the first time as fossils, while *Cyrtonyx montezumae* is recorded paleontologically for the first time anywhere in the United States. New Arizonan fossil records include *Colinus gambelli, Colinus* species, *Zenaida* cf. *Z. macroura, Otus* species, *Asio otus,* the indeterminate caprimulgid, icterine, and *Colaptes auratus.*

Mammals are the best known group of fossil vertebrates from Arizona. Twenty-two mammals are identified from Deadman Cave, most of which can be found in the Santa Catalina Mountains today or in the surrounding valleys. Exceptions are the three large extinct species (*Equus* species, *Nothrotheriops shastensis,* and *Euceratherium collinum*) and *Microtus* species which lives 60 km to the east of Deadman Cave.

Paleoenvironment of Deadman Cave

The amphibian remains indicate that the region around Deadman Cave was at least as moist at the time of deposition as it is today. Certainly pools of water were nearby as they are today in portions of the Santa Catalina Mountains and along the major streams and rivers. The lizard fossils argue for either a community that was a composite of today's vegetational communities, or, a few vegetation groups abutting each other in close proximity to the cave. The presence of *Phrynosoma modestum* suggests that a desert-grassland area may have occurred on the broad flat hills above the large river valley, at the base of the mountain mass. *Callisaurus draconoides, Holbrookia texana, Sceloporus magister,* and *Heloderma suspectum* indicate a more-or-less open desertscrub to desert-grassland. Such areas could easily abut an open woodland. This community would probably be in the lower part of the bajadas between hills. The rest of the lizard fauna indicates several vegetation communities ranging from desert and desert-grassland to woodland. Certainly some areas of talus or rock outcrops were nearby. Most of the snake population from Deadman Cave suggests little to distinguish the region then from what it is today, although *Gyalopium canum* indicates a cool grassland habitat.

Except for the possibly extinct icterid, the entire avifauna of Deadman Cave consists of living taxa that occur today in southern Arizona. No birds in the fauna are restricted to coniferous habitats. In fact, *Colinus gambelli* and *Micranthene whitneyi* argue strongly against any sort of adjacent coniferous forest. *Colinus gambelii* suggests the presence of desertscrub, while *Cyrtonyx montezumae* is characteristic of open oak woodlands, and pine-oak woodlands. *Cyrtonyx* is the only bird from Deadman Cave that is not found at least occasionally in desertscrub today, although *Turdus migratorius* and *Catharus guttatus* are certainly more abundant in wooded areas than in desertscrub, and never nest in the latter. The fossil birds from Deadman Cave suggest a slightly more grassy and wooded condition in the Latest Pleistocene and Earliest Holocene than today, such as an evergreen oak grassland mixed with desertscrub and desert-grassland on the more xeric exposures, and oak woodland on more protected, mesic areas.

The mammals generally indicate an open woodland with some areas more vegetated and other areas more xeric and open. None of the mammals are restricted to forested habitats, although many of them do occur today in the forested higher elevations of nearby larger mountains. *Notiosorex crawfordi, Microtus* sp., *Reithrodontomys montanus,* and *Euceratherium collinum* may argue for an open, possibly grassy woodland. Today this sort of habitat occurs just a few hundred meters upslope from Deadman Cave. *Perognathus* cf. *P. flavus, Dipodomys spectabilis, Thomomys* cf. *T. bottae,* and *Sigmodon* cf. *S. arizonae* indicate that a desertscrub to desert-grassland was nearby.

No distinctly boreal or mesic mammals (e.g., *Sorex ornatus,* Ornate shrew; *S. palustrus,* Water shrew; *Ochotona princeps,* Pika; *Marmota flaviventris,* Yellow-bellied marmot; *Glaucomys sabrinus,* Northern flying squirrel) were recovered from Deadman Cave. This may be because the faunal assemblage is of Late Wisconsinan–Early Holocene transition in age, and the boreal-mesic (full glacial) elements had already become extirpated locally. This may be the case with the *Spermophilus lateralis* from Ventana Cave. An alternative is that most of these elements never did occur in southern Arizona during the last Wisconsinan full and late glacial (assuming that the Papago Spring Cave deposit is Middle Wisconsinan or older in age). Presumably if any geographically or ecologically extralocal small animals, such as listed above, were contemporaneous with the Shasta ground sloth, Horse, and Shrub-ox, they too would have been observed in the Deadman Cave deposit.

The Deadman Cave faunal record is very similar to those of Early Holocene–Late Pleistocene wood rat faunas in the Sonoran Desert (Van Devender and Mead 1978, Mead et al. 1983) and Grand Canyon (Van Devender et al. 1977, Mead and Phillips 1981) in that the small vertebrates were conservative with few animals out of their present range, although there was a greater change in the local vegetation. The pollen record at Willcox Playa, 80 km east of the Santa Catalina Mountains, recorded a pine forest at 1200 m elevation 20 000 years ago in an area that now supports desert-grassland (Martin 1963). This is an estimated lowering of the vegetation zones by about 1000 m elevation. The wood rat midden record for lower areas in the Sonoran Desert in southwestern Arizona recorded a complex elevational lowering of 600 m or less of certain woodland plants into the desert. An equivalent lowering of vegetation zones in the Santa Catalina Mountains would imply a shift from the modern desert-grassland-oak woodland vegetation to Pondersoa pine mixed conifer forest or a Mexican pine-oak woodland, depending on the distribution and abundance of precipitation in the Late Wisconsinan (Whittaker and Niering 1968). In the Early Holocene a Mexican pine-oak woodland was probably near the site until about 8000 years ago with the grassland developing more recently. Like the *Microtus* sp., a population of *Abies lasiocarpa* (Corkbark fir) presently on the top of the Santa Catalina Mountains, is also isolated from its nearest population in the spruce forests of the Pinaleño Mountains. Most of the remaining Deadman Cave fauna would be found in some sort of open woodland today. Several animals including *Callisaurus draconoides, Heloderma suspectum, Dipodomys spectabilis, Phrynosoma modestum,* and *Colinus gambelli* do not live in Mexican pine-oak woodland today and are more likely to occur in open desert-grassland or desertscrub and may represent the Early Holocene portion of the Deadman Cave deposit. Another possibility which has been demonstrated for a few animals in the Sonoran Desert (Van Devender and Mead 1978; Mead et al. 1983) is that under an equable Late Wisconsinan climate certain animals now confined to deserts were able to live in more diverse woodland communities.

Conclusions

The vertebrate fauna of Deadman Cave includes 5 amphibians, 25 reptiles (13 lizards and 12 snakes), 12 birds, and 22 mammals for a total of 64 species. The implication from this faunal assemblage is that by the end of the late glacial and the beginning of the post glacial (8000–12 000 B.P.), most of the local fauna was essentially as it is today—modern. Only one amphibian (*Bufo woodhousei*), three reptiles (*Callisaurus draconoides, Phrynosoma modestum, Gyalopium canum*), and one mammal (*Microtus* species) are locally extirpated, although all still occur in southern Arizona. Animals unequivocally extinct are the Shrub-ox, Horse, and Shasta ground sloth, all large mammals. An unidentified icterine bird may prove to be an extinct species. Overall, the Deadman Cave fauna suggests that the vegetation community of the Late Pleistocene and Early Holocene were rather similar to those found today in the same region.

The Deadman Cave bone assemblage has expanded our knowledge of the Late Pleistocene–Early Holocene fauna of southern Arizona, and has provided new questions on Late Pleistocene zoogeography of the hot deserts. Further stratified and datable cave deposits and wood rat middens need to be studied to refine when the faunas of southern Arizona became "modern." Upland localities need to be studied to determine whether boreal and/or mesic faunal elements ever existed in the Late Wisconsinan of southern Arizona, and whether the presently extralocal and local faunal assemblages ever coexisted.

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